as in Man, but not so lasting a union between the anterior cerebrals as in the Potto. Finally it may be noted that while in the two species of *Lemur* the union of the two anterior cerebellar arteries takes place just in front of the optic chiasma and also at right angles to the subsequent course, thus resembling the anterior communicating artery of Man, the junction of the same two arteries in the Potto is invisible until the hemispheres are separated, and is thus oblique, as it is in such Monkeys, Rodents, and Carnivora that I have been able to examine.

5. On the Pelvis and Hind-limb of *Mullerornis betsilei* M.-Edw. & Grand.; with a Note on the Occurrence of a Ratite Bird in the Upper Eocene Beds of the Fayum, Egypt. By C. W. Andrews, D.Sc., F.Z.S. (British Museum, Natural History).

[Received January 14, 1904.]

(Plate V.* and Text-figure 15.)

Among the numerous bird-remains brought back from Central Madagascar by Dr. Forsyth Major are some beautifully preserved bones of the pelvis and left hind-limb of a small ratite bird referable to the genus *Mullerornis* of Milne-Edwards and Grandidier †. The femur, tibio-tarsus, fibula, and tarso-metatarsus, as well as a considerable portion of the pelvis, were found in natural association, but none of the phalanges were preserved. No detailed description of any member of the genus having ever been published, a brief account of these specimens may be welcome. It may be said at once that these bones differ in no very striking manner from those of *Æpyornis*, and that they do not appear to throw any further light on the affinities of the Æpyornithidæ as a whole.

Of the three species of *Mullerornis* distinguished by Milne-Edwards and Grandidier, the bird in question agrees very nearly (in its dimensions) with *M. betsilei*, and since, moreover, it is from the same locality, it may be regarded as belonging to that species.

The Pelvis (Plate V. fig. 1).—The pelvis, which seems to have been very long and narrow, is very badly preserved; of the ilia the only portion in a tolerably perfect condition includes the acetabular region and a short distance behind it, while the pubes and ischia are represented by mere stumps only. In the preacetabular region of the pelvis the upper edges of the ilia must have united to form a strong iliac crest; just over the antitrochanter they diverge, forming the supra-trochanteric crests which constitute the anterior boundaries of the pelvic escutcheon, of which in the

* For explanation of the Plate, see p. 171.
† Comptes Rendus, t. cxviii. 1894, p. 125.

present specimen only the anterior end is preserved. The synsacrum is represented by about fourteen vertebræ. The acetabulum is large and nearly circular in outline; its ventral border lies above the ventral surface of the synsacrum. The acetabular foramen is a large, roughly triangular opening through which the arches of the vertebræ of that region can be seen: the antitrochanter is very large. The region of the pectineal process is much abraded. Only the proximal portions of the ischia and pubes are preserved; they are intimately fused with the centra of the synsacral vertebræ, which, as described below, there form a ventral prominence. There is no very definite ridge uniting the two ischia across the synsacrum as in some specimens of the pelvis of *Æpyornis*, and therefore the postsacral furrow of Burckhardt is scarcely at all developed.

In the syncracum there are eleven or twelve vertebræ in front of the true sacrals. Of these the seven anterior lie in front of the acetabulum and the point of origin of the pubes; the other four or five are crowded together between the acetabula, and are so closely fused with one another that they can only be distinguished from one another by the foramina perforating their fused arches.

The first synsacral bears a facet for a rib-head, situated on the side of the centrum close to the anterior articular surface: the transverse process has been broken away. The base of the neural arch is excavated by a deep pocket-like fossa. The neural spine is broken away to a great extent, but it can be seen that its base was strengthened by six buttress-like lamellæ of bone, of which two are placed longitudinally, two others run outwards and a little forwards on to the transverse processes; the two remaining ridges run midway between the last-mentioned plates and the postero-median one. There is a small hypapophysis situated immediately behind the anterior surface of the centrum.

The second vertebra has a broad transverse process the base of which is excavated by a large pneumatic fossa divided into two chambers by a vertical lamella of bone. There seem to have been no articular surfaces for ribs, but the bone is somewhat incomplete where they should occur. There is a very slightly marked hypapophysis on the front of the ventral surface. The next vertebra is similar except that there is no trace of a hypapophysis. In the next the transverse process is smaller and more backwardly directed, but it is not, as in *Æpyornis*, divided into a dorsal and ventral bar. This division, however, occurs in the next (5), in which the ventral bar is small and forwardly directed. The same is the case in the following two (6 and 7). In none of these hinder vertebræ (3–7) is there any hypapophysis. The outer ends of the parapophyses, which are separated by oval foramina, are intimately united with the ilia.

The centra of the eighth to the eleventh (or twelfth) vertebræ are fused with one another and with the proximal portions of the pubes and ischia. The united centra form a ventral prominence convex antero-posteriorly, but this projection is not bounded posteriorly by a well-marked groove as in *Æpyornis*. The centra of the succeeding (post-acetabular) vertebræ do not run in quite the same straight line as those in front, but slope somewhat upwards, so that the preacetabular region of the synsacrum makes a slight angle with the post-acetabular, the two being separated by the ventral prominence of the inter-acetabular centra.

In the thirteenth, fourteenth, and fifteenth vertebræ there are ventral processes, of which the anterior two are perhaps to be regarded as the true sacral ribs; the outer ends of these processes unite externally into a common mass which abuts on the ilium immediately behind the acetabulum, and at the same time forms the hinder wall of the cavum acetabulare. Of these processes, that of the thirteenth vertebra is slender and directed backwards, that of the fourteenth stouter and running directly outwards, that of the fifteenth much the largest and directed forwards; the centra of these three vertebræ are flat below.

The sixteenth vertebra bears a long and broad transverse process, which runs outwards and backwards, and widens out externally, joining the ilium immediately beneath the antitrochanter; the upper edges of these transverse processes are continued upwards into thin cribiform plates which unite above with the neural spine. The next transverse process is more slender but bears a similar plate, and, judging from the pelvis of *Æpyornis*, these plates were present in all the succeeding postsacrals, and are so arranged that they divide the posterior portion of the pelvis into a series of narrow chambers. In the present specimen all behind the seventeenth vertebra are broken away.

The dimensions of the pelvis are:—	cm.
Length of synsacrum as far as preserved.........	26
Approximate width between outer ends of the antitrochanters	13
Width between ventral edges of acetabula	7·5
Vertical diameter of acetabulum	4
Width in front of acetabulum	6

The Femur (Plate V. figs. 2 & 3).—The femur is rather more slender in proportion to its length than in *Æpyornis mulleri*, but otherwise is not strikingly different. The neck is very short and the head is shaped somewhat like the frustrum of a cone, the upper end of which is represented by the smooth surface which fits into the acetabular foramen. The trochanteric surface is continuous with that of the head, and the trochanter itself is less massive and projects less forwards than is the case in *Æpyornis*: its outer surface is deeply marked by the attachments of muscles (glutei, &c.). On the hinder face of the bone, immediately beneath the edge of the trochanteric surface, there is a large pneumatic foramen (*pn.f.*) partly closed by a cribriform plate of bone.

The shaft is slightly compressed owing to the flattening of the anterior and posterior surfaces, and this flattening is especially marked towards the lower end, where the bone widens out towards the distal articulation. The popliteal fossa is deep, and there are several pneumatic foramina (*pn.f.*) opening into it; it is more strongly defined and extends further up the bone than in *Æpyornis*. The trochlear surface is rather flattened, and is separated from the intercondylar groove by a well-defined angle. The broad intercondylar groove is marked with two or three deep pits for the attachment of ligaments. The inner condyle is much as in *Æpyornis*, but in the outer the fibular surface is broader and the short ridge forming its supero-internal border is much more prominent.

Near the middle of the shaft and on its postero-external border there is a small nutritive foramen.

The Tibio-tarsus (Plate V. figs. 4 & 5).—The tibio-tarsus is relatively more slender than that of *Æpyornis mulleri*, and the antero-posterior compression of the shaft is a little less marked. The cnemial crests are well developed and rise high above the articular surface. Immediately beneath the rim of the hinder edge of the proximal articulation there is a deep concavity into which several foramina, probably pneumatic (*pn.f.*), open.

The distal portion of the shaft is greatly flattened from before backwards, and its anterior face is slightly concave from side to side. This concavity is deepest at the groove for the extensor tendons, which runs farther up the bone than in *Æpyornis* and is not quite so near the inner margin. The groove is bordered externally by a long and prominent ridge, and on the inner side by a short projection (fig. 5, *t*), which is evidently the partially ossified base of the otherwise tendinous bridge over the extensor tendons. The distal articulation is almost exactly like that of the tibia of *Æpyornis mulleri*. The so-called middle trochlea, a slight convexity between the outer and inner condyles, is very slightly developed. The post-condylar processes are sharply marked off from the condyles, and the outer at least projects more than in *Æpyornis*.

The Fibula (Plate V. fig. 6).—The fibula as far as preserved is 160 mm. long. Its upper end is large, and in correlation with the large size of the fibular surface of the femur it bears a large articular surface which extends a considerable distance down the outer side of the shaft. The surface for articulation with the fibular prominence of the tibia is oval and deeply concave. About a third of the length of the bone from its distal end there is a prominent tubercle for the insertion of the *biceps cruris*.

The Tarso-metatarsus (Plate V. figs. 7 & 8).—The tarso-metatarsus is a comparatively slender bone, and in general structure corresponds entirely with that of one of the smaller species of *Æpyornis*, e. g. *Æ. hildebrandti* as described by Burckhardt. In the proximal articulation the surface for the inner condyle of the tibia is much the larger, and is much wider antero-posteriorly than that for the outer condyle; there is no intercondylar process, but, on the other hand, there is a slight median concavity for the reception of the so-called middle trochlea of the tibia. The upper part of the anterior face of the shaft is deeply concave owing to the posterior position of the upper end of the middle metatarsal; this concavity runs about three-quarters of the way down the shaft, and even below this the anterior face is slightly grooved for the adductor tendons. The inter-osseous foramina open at the same level anteriorly, and immediately beneath them is the single large tuberosity for the insertion of the tendon of the *tibialis anticus*. On the posterior surface of the bone, the upper end of the third metatarsal forms the bulk of the large talon, consisting of a prominent ridge on the outer side and a small tuberosity on the inner, separated by a shallow groove for the tendons. The main ridge of the talon is continued down the upper three-fourths of the trihedral shaft, of which it forms the posterior angle. In section, the middle portion of the shaft is triangular, the sides of the triangle being concave and the concavity of the anterior face being the deepest. A little above the distal articulation the shaft is convex in front and slightly concave behind. The middle trochlea is much the largest of the three and extends considerably beyond the inner one, which in size and form closely resembles the outer, much more nearly, indeed, than is the case in *Æpyornis*. Just above the notch between the outer and middle trochleæ, the bone is perforated by two foramina, one above the other but close together: of these the upper one (*add.*) pierces the bone and opens on the palmar aspect at the posterior end of the channel between the two trochleæ, the other opens in the middle of the same channel; the upper or posterior of these perforations probably transmitted the tendon of the *adductor digiti externi*, but the function of the other is unknown to me.

In a note on some remains of *Æpyornis* in the Tring Museum published some years ago*, I ventured to suggest that *Mullerornis rudis*, the metatarsal of which is said to be perforated by the tendon of the *adductor digiti externi*, should on that account be referred to a new genus, *Flacourtia*. If the presence of this character were really of generic value taken alone, the present species should likewise be referred to *Flacourtia*; but since the presence or absence of this perforation seems to be of very variable occurrence, it will be better to refer all the small, lightly built Æpyornithidæ at present known to one genus, *Mullerornis*, at least till some more valid distinctions are found, which may very well happen when the skulls and skeletons of the various species are known.

So far as can be seen, the thickening of the bones (pachyostosis), though of course much less in degree than in *Æpyornis*, is of precisely the same kind as that described by Burckhardt in the case of *Æpyornis hildebrandti*, and differs from the type found in the Dinornithidæ, in which the bones are much more solid and heavier.

* Novitates Zoologicæ, vol. ii. p. 25. Tring, 1895.

As already mentioned at the beginning of this paper, these specimens throw no light on the relationships and origin of the Æpyornithes, and it seems that in Madagascar we have a group of closely interrelated Ratites, varying enormously in size and in the degree of pachyostosis attained, but otherwise presenting few differences of importance, just as in New Zealand all degrees of size and massiveness exist between *Dinornis parvus* and *D. maximus* or *Pachyornis elephantopus*. In Madagascar, so far as known at present, the extremes are *Mullerornis agilis* and *Æpyornis titan*.

The dimensions of the limb-bones described are given below; those of the pelvis have already been noticed.

	cm.
Femur:	
Length	235
Width of the proximal end	8·4
Antero-posterior diameter of the shaft	2·9
Lateral diameter of the shaft	3·5
Width of the distal end	3·7
Tibia:	
Length to top of articulation	40·5
Length to top of cnemial crest	43·5
Width of the proximal end	6·2
Width of the middle of shaft	2·8
Width of distal end	6·2
Antero-posterior diameter of the shaft	2·0
Fibula:	
Length	upwards of 16·0
Antero-posterior width of proximal end	3·4
Lateral width of proximal end	1·6
Metatarsus:	
Length	27·3
Width of the proximal end	6·6
Width of shaft at narrowest	2·7
Width of the distal end	6·5
Width of the middle trochlea	2·5

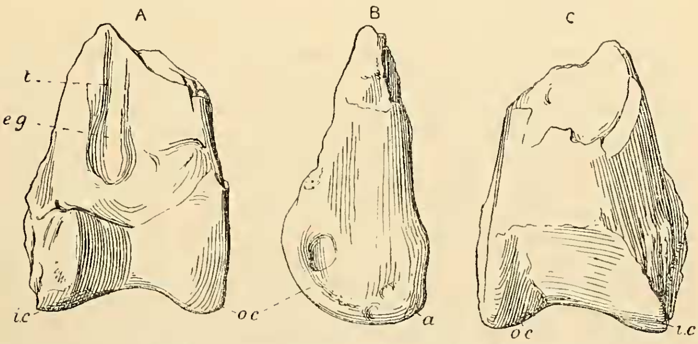
Note on a new Ratite Bird (*Eremopezus eocænus*, gen. et sp. nov.) from the Upper Eocene of the Fayum District, Egypt.

(Text-figure 15.)

One of the most interesting specimens collected from the Upper Eocene beds of the Fayum in 1902 is the distal end of the left tibio-tarsus of a large ratite bird. The fragment consists of the articulation and four or five centimetres of the shaft, and, except for a slight abrasion of the inner condyle, is in a sufficiently good state of preservation for it to be possible to observe all the important points in the structure of this highly characteristic portion of the skeleton. In fact, although of course much more material is necessary before the precise affinities of this bird can be fully determined, probably from no similar fragment of any other bone of the skeleton could so much information be derived.

The outer condyle, the upper angle of which extends some distance up the antero-external border of the bone, seems to be larger in proportion to the inner than in the other Ratites except possibly *Struthio*. The condyles are very distinctly separated by a very well-marked intercondylar groove, in this respect more resembling the tibiæ of *Casuarius* and *Rhea*, and differing from those of *Æpyornis* and *Struthio*, in which the groove is very shallow. The post-condylar processes are not nearly so prominent as in *Struthio*, but about as in *Dromæus*; the outer post-condylar process does not extend nearly so far upwards as the condyle does anteriorly, and is sharply separated from it almost at a right angle (see text-fig. 15, B, *a.*) which forms the most distal point of the bone. The consequence of this arrangement is that the condylar articular surface looks more forward than is usually the case, though some approximation to this condition is seen in *Struthio*, and still more in *Rhea*. The surface between the post-condylar processes is slightly concave and passes gently into the posterior surface of the shaft, which, like the whole articular end of the bone, is strongly compressed from before backwards. The lateral faces of the condyles bear deep pits for the attachment of ligaments (text-fig. 15, B).

Text-fig. 15.



Distal end of left tibio-tarsus of *Eremopezus eocænus*.

A. From front. B. From side. C. From back.

a., angle between outer condyle and post-condylar surface; *e.g.*, extensor groove; *i.c.*, inner condyle; *o.c.*, outer condyle; *t.*, tubercle marking position of extensor bridge.

The figures are $\frac{2}{3}$ natural size.

The posterior face of the shaft passes by a gentle slope into the sharp antero-internal border of the bone, which is continuous with the upper angle of the inner condyle, as in *Casuarius* and *Dromæus*. The anterior face of the shaft near its inner border is deeply channelled by the groove for the extensor tendons (text-fig. 15, A, *e.g.*); this groove is closed at its lower end by a strong ridge running upwards and outwards towards the outer border, and forming a prominent rugose surface above the outer condyle. There was no bony bridge over the tendons, but a slight ridge along the inner side of the groove marks the insertion of a strong tendinous sling (see text-fig. 15, A, *t.*).

Comparing this specimen with the tibio-tarsi of the other Ratites, it may be said that to some extent it combines the characters of several of them. In the depth of the extensor groove it approximates to *Rhea* and *Æpyornis*. The oblique ridge which blocks the lower end of the groove occurs also in *Struthio*, though in this case the groove itself is much shallower. In *Æpyornis*, on the other hand, the ridge is entirely absent and the groove runs nearly down to the condyles. The form of the outer condyle and its relations to the post-condylar process are similar to what is seen in *Rhea* and to some extent in *Struthio* also.

It seems clear that this bird differs widely from the other Ratites, and certainly from any of the Carinatæ, and I propose to name it *Eremopezus eocænus*.

The dimensions of the type specimen are:—

	cm.
Width of distal articular end	4·8
Width of lower end of shaft (at highest point preserved)	3·5
Width from front to back of the outer condyle	3·5

The occurrence in this region and in beds of Eocene age of a Ratite bird is a matter of considerable interest; but until sufficient remains are found to give a more definite idea of the relationships of this form, it will be unwise to draw any very wide conclusions. At the same time, it may be remarked that the existence of a true Ratite so long ago as the Eocene makes it at least possible that some of the main groups of the Ratitæ may have had a common ancestry, and are not the results of separate retrogressive modifications leading to the loss of flight, with the various correlated changes. In the present case the relationship between the Struthiones and the Æpyornithes, referred to by Burckhardt *, is naturally suggested; and the occurrence of Struthious birds (*Struthio* and *Hypselornis*) in the Pliocene of the Siwalik Hills may possibly indicate some remote connection between the present form and the *Dromæus-Casuarius* group. There is, however, another possibility that must not be lost sight of, and that is, that after all *Eremopezus* may be merely another instance of retrogressive modification leading to loss of flight and increase of bulk in a group of Carinate birds, such as has occurred in the case of the Stereornithes, the Gastornithes, and

* "Ueber *Æpyornis*," Palæont. Abhandlungen, N. F., vol. ii. p. 145 (Jena, 1893).